Ornis Fennica 73:137–140. 1996

Brief report

Scottish Snow Bunting *Plectrophenax nivalis* breeding and climate

Adam Watson

Watson, A., c/o Institute of Terrestrial Ecology, Banchory AB31 4BY, Scotland

Received 21 March 1996, accepted 30 May 1996

Introduction

As Snow Buntings breed in an extreme environment, it is of interest to understand how they perform in severe conditions. This paper compares their breeding success in 1970–87 with snow cover and summer weather on Scottish alpine land, where they are at an oceanic south end of their mainly arctic breeding distribution. On the same area, Nethersole-Thompson (1966) made pioneering observations in earlier decades, and Smith and Marquiss (1994, 1995) did full-time work with marked birds in 1988–93. I had no marked birds, but the 18-year run allowed correlation tests impossible with short runs. It also involved, as expected, interesting greater extremes of variation in snow cover, summer snowfalls, and breeding timing and success.

Ideas suggested by above authors were: — does late snow cover delay breeding, are the timing and proportion of second broods related to the timing of firsts, do birds breed well in warm summers or when extensive snow forms many insect traps, and do they breed poorly in summers that are rainy or have fresh snowfalls? I tested these ideas.

Study area and Methods

The area covered 16 km^2 at 1 000–1 300 m on Cairn Gorm plateau 100 km west of Aberdeen (description and map in Smith 1994).

As birds were scarce in some years, I could tell most cocks and some hens apart within months by sketching their individual plumage characters, especially on the head, nape and rump. It was easy to miss birds (Watson & Smith 1991), so numbers given are minima. I concentrated visits when adults were conspicuous, just before laying, when nestlings were big, and when fledglings had just left nests.

I saw nests in shallow holes, and in deep holes by torch and mirror. A few were too deep, but the parents' behaviour showed the stage of breeding, and I saw these broods at fledging or shortly after.

I observed some hatch dates. Plumage and body development at known ages (Maher 1964, Smith & Marquiss 1994) helped estimate dates for broods whose hatching I had not observed. I estimated hatch dates to the nearest day, but estimates at 1–3 weeks were accurate only to ± 2–3 days, as young in a brood varied in development. As most variation involved runts, I used the largest chick's estimated age.

The percentage of land under consolidated deep snow left from the winter and spring was estimated from the same vantage point at the start of June (Milsom & Watson 1984). Percentages were transformed (angular) for analysis.

I noted fresh snowfalls in May–August, excluding falls outside the observed breeding season each year. For each day I gave a score of 1 for fresh snow lying all day on the area's highest parts, plus an extra 1 for it lying all day on all parts, plus an extra 1 for drifting snow all day. Annual scores ranged from 0 in nine years to 18 for six consecutive days in 1978.

As there were no climate data on alpine land in some years, I used records from Braemar village at 339 m in a nearby valley (Monthly Weather Report, Meteorological Office, Bracknell, England).

Clutch size, clutch loss and hatching success

Clutch sizes resembled those in Nethersole-Thompson (1966) and Smith (1994). As the literature gave no hint of clutch size varying between years, I lumped data for all years. Clutch sizes varied from 3 to 6. Sizes of presumed first clutches exceeded those of presumed seconds (x = 5.2 and 4.8, Mann-Whitney U = 18, P < 0.1, n = 13 and 6). At 19 nests followed from laying to fledging, no egg vanished, one clutch failed, 94% of remaining eggs hatched, and 89% of the initial 98 hatched. These values are maxima, as nests failing during laying or early incubation may be missed. All young died in four broods, out of 87 eggs hatching. From the 15 successful nests, 65 young left.

At 21 nests followed less often, two failed during incubation and two with young. So, out of 40 nests with eggs, three were deserted during incubation and six with nestlings. All these failures involved presumed first clutches or broods in snowfalls, with no predation.

The number of second clutches, expressed as a percentage of the number of firsts, varied from 0% in 1977 and 1986, to 100% in 1979. For all cases it was 37% out of 83 firsts.

Fledged brood sizes ranged from 2 to 5. The sizes of presumed firsts exceeded those of seconds (x = 3.8 and 2.9, U = 35, P < 0.01, n = 22 and 12), as in Smith and Marquiss (1995).

Some broods were complete long after nest departure (seen in six years, range 7–23 days, n = 35 young in 8 presumed firsts and 4 seconds, total of young-days = 506). This showed total survival that can occur, not mean survival, as other broods had fewer young when seen later, and I did not know if this was due to death or movement.

Hatch dates

Earliest dates were 7 June 1976 and 8 June 1970, 1976 and 1981, and latest ones 31 July 1985 and 8 August 1984 for presumed seconds. The late years 1977 and 1986 had no seconds (Fig. 1), after snowfalls delayed the main thaw till 18 and 12 June respectively.

The time between two broods was observed in six years where I saw a hen with a first nest and brood, next making a second nest while feeding her first fledglings, and then with a second nest and brood. A month separated the two broods at nest departure (x = 31.3 days, SD = 2.29, range 29–36, n = 7).

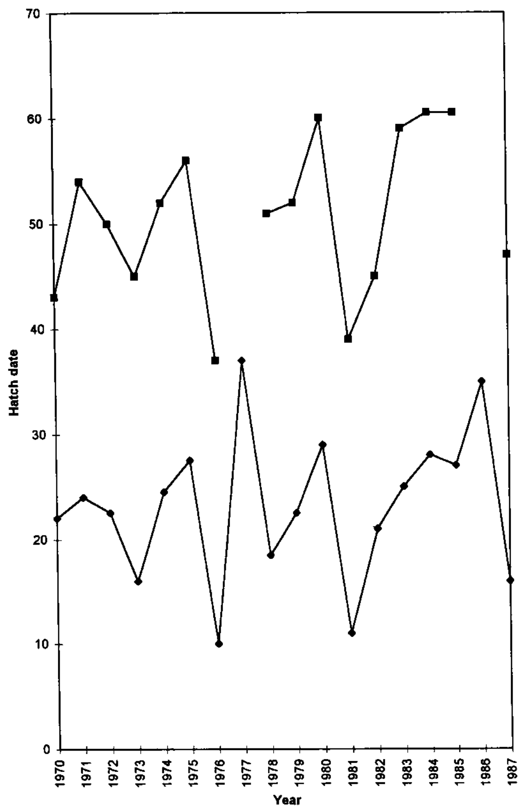

Fig. 1. Median hatch dates (days after 31 May) for presumed first clutches (lower graph) and presumed seconds (upper), omitting two replacement clutches after loss of firsts. For firsts, annual n = 2–6, x = 3.9, SD = 1.55. For seconds, n = 1–5, x = 1.72, SD = 1.23.

The number of second hatches per hen seen with a clutch or brood was only weakly associated with the median date of firsts (r_{16} = – 0.40, P = 0.10). However, the median date of seconds was strongly related to that of firsts (Fig. 1, r_{14}=0.90, P < 0.001).

Breeding timing and success versus snow cover and weather

Snow cover at the start of June varied from 15% in 1981 to 98% in 1977. It was related to the median hatch date of first clutches (r_{16} = 0.58, P < 0.02), so birds bred late in snowy years.

In a few years I observed the total number of young at nest departure with all known successful hens. However, the only success parameter recorded in all years was the number of first plus second broods reared per hen seen with a clutch or brood. It ranged from 0.5 in 1978 to 1.8 in 1979 (range of annual values 0.5 in 1978 to 1.8 in 1979, x of annual values = 1.33, and x of all broods in all years = 1.30). As 75 of 107 broods were seen only after nest departure, early failures may be missed and the above values are maxima.

The number of broods reared per hen seen with a clutch or brood was unrelated to June–July mean air temperature or rainfall in the valley ($r_{16} = 0.18$ and 0.16 respectively, $P > 0.1$ in both).

The number of clutches and broods lost per hen was strongly related to the score for fresh summer snowfalls on the study area ($r_s = 0.81$, $P < 0.001$, $n = 18$). Most failures with first clutches or broods were associated with fresh snowfalls, and Smith and Marquiss (1995) found first broods deserted in a snowstorm.

A 6-day chick died in a first brood and three 7-day ones in a second, without all the brood dying and without fresh snowfalls. Smith and Marquiss (1995) suggested that late young were more likely to starve.

As they noticed poor breeding in a summer with few snowbeds, I tested this idea with my data. The number of broods reared per hen seen with a clutch or brood was unrelated to snow cover at the start of June ($r_{16} = -0.258$, $P > 0.1$, $n = 18$; and note the negative sign).

To conclude, breeding timing and the proportion of second broods varied greatly between years. Extensive snow cover left from the winter delayed the onset of breeding, and the proportion of second broods was lower in such years. Breeding success was unrelated to the extent of snow, or to valley temperature or rainfall, but was related to the severity of snowfalls when birds had eggs or dependent young. So, climate influenced breeding timing, breeding success, and the proportion of second broods.

The relation between breeding timing and snow cover tells nothing about the mechanism. In years when heavy fresh snow covered all food before nesting began, I saw no birds on the area. On such days I found pairs on nearby land with incomplete snow cover, where no nesting birds were seen in any year. In several such cases I saw pairs eating human food scraps beside a restaurant at 1 100 m, and others on snowfree land lower down.

In years with deep snow from the winter and many snowfalls in April–June, it may be risky to nest early, as drifts may block nest holes. The likelihood of this falls as the summer progresses, but so does the time left to breed. There may be a trade-off between these two.

One might ask why do birds not breed very early in unusually and consistently snowfree springs? In 1981 they did nest early, but still not till mid May, even though most of the area was snowfree by early April and remained so. Big areas of snowfree land may be necessary for breeding to start, but not sufficient, as hatching may have to coincide with insect abundance for chick food.

Acknowledgements. R. Smith, M. Marquiss and two anonymous referees made valuable comments.

Selostus: **Pulmusen pesintä ja ilmasto Skotlannissa**

Kirjoittaja tutki pulmusen pesimäbiologiaa Skotlannissa vuosina 1970–1987 ja sitä, kuinka lumipeitteen sulaminen ja kesän sääolosuhteet vaikuttivat pesintään. Pesyekoko vaihteli kolmesta kuuteen ja oli keskimäärin 5.2 munaa ensimmäisissä ja 4.2 toisissa pesyeissä. Tarkemmin tutkituista 19 pesästä vain yksi tuhoutui, ja näissä olleista alunperin 98 munasta 89% kuoriutui. Näistä pesistä 15 pesää tuotti yhteensä 65 lentopoikasta. Keskimäärin lentopoikasia oli 3.8 ensimmäisissä ja 2.9 toisissa pesyeissä. Pesimismenestys ei riippunut lumen määrästä pesimäkauden alussa tai läheisen säähavaintoaseman lämpötiloista ja sademääristä. Sen sijaan lumisateiden ankaruus aikana, jolloin linnuilla oli munia tai poikasia, selitti pesätuhoja hyvin. Kirjoittaja ei havainnut yhdenkään pesän joutuvan saalistetuksi. Toisia pesyeitä populaatiossa oli keskimäärin 37% suhteessa ensimmäisten pesyeiden määrään vaihdellen 0 ja 100%:n välillä. Keskimääräinen ensimmäisten pesyeiden kuoriutuminen tapahtui 7. kesäkuuta ja 6. heinäkuuta välillä vaihdellen kesän sääolosuhteiden mukaan. Toiset pesyeet kuoriutuivat noin kuukausi ensimmäisten pesyeiden jälkeen (Kuva 1). Kaikkein myöhäisimpinä vuosina (1977 ja 1986) toisia pesyeitä ei havaittu.

Pulmuset pesivät myöhään vuosina, jolloin tutkimusalueella oli lunta kesäkuun alussa. Ne kuitenkin aloittivat pesinnän aikaisintaan vasta toukokuun puolivälissä, vaikka lumi kyseisenä vuonna olisikin sulanut jo huhtikuussa.

References

Maher, W. J. 1964: Growth rate and development of endothermy in the snow bunting (Plectrophenax nivalis) and Lapland longspur (Calcarius lapponicus) at Barrow, Alaska. — Ecology 45: 520–528.

Milsom, T. P. & Watson, A. 1984: Numbers and spacing of summering Snow Buntings and snow cover in the Cairngorms. — Scott. Birds 13: 19–23.

Nethersole-Thompson, D. 1966: The Snow Bunting. — Oliver & Boyd, Edinburgh & London.

Smith, R. D. 1994: Snow Buntings breeding in the Cairngorms: population dynamics and the influence of recreation. Scottish Natural Heritage, Perth.

Smith, R. D. & Marquiss, M. 1994: Breeding seasons and nesting success of Snow Buntings in north-east Scotland. — Scott. Birds 17: 223–234.

Smith, R. D. & Marquiss, M. 1995. Production and costs of nesting attempts in Snow Buntings Plectrophenax nivalis: why do they attempt second broods? — Ibis 137: 469–476.

Watson, A. & Smith, R. 1991: Summering Snow Buntings in Scotland in 1970–87. — Scott. Birds 16: 53–56.